

inherently disclosed the claimed materials or methods useful in producing the claimed materials. In particular, the materials include nanoparticles with narrow particle size distributions.

Applicants note that a Declaration by Dr. Kambe, an expert on nanotechnology, is already of record indicating that generally the technology to produce the claimed nanoparticles was not known. Applicants will next focus on more direct evidence regarding the specific references.

Rejections Under 35 U.S.C. §112

These issues were addressed in the Amendment of May 1, 2000. While the Examiner did not indicate in the Advisory Action of May 19, 2000 that this rejection had been overcome, Applicants believe that this is the case. If the Examiner still believes that there are section 112 rejections relevant for the amended claims, Applicants request notification by the Examiner.

Rejections Under 35 U.S.C. §103(a) Over Single References

The Examiner rejected claims 1-3, 5-8 and 19-22 as being unpatentable over any one of U.S. Patents 4,861,572 to Sugoh et al. (the Sugoh patent), U.S. Patent 4,705,762 to Ota et al. (the Ota patent), U.S. Patent 5,635,154 to Arai et al. (the Arai patent), U.S. Patent 5,417,956 to Moser (the Moser patent) and U.S. Patent 5,447,708 to Helble et al. (the Helble '708 patent). While Applicants maintain that their previous arguments were sufficient to overcome the pending rejections, Applicants do not reiterate those rejections. Instead, Applicants present evidence that the references do not teach or suggest approaches suitable for the production of the claimed materials.

The proposition is well established that the prior art only renders a composition of matter unpatentable to the extent that the prior art provides a means of obtaining the composition.

To the extent that anyone may draw an inference from the Von Bramer case that the mere printed conception or the mere printed contemplation which constitutes the designation of a 'compound' is sufficient to show that such a compound is old, regardless of whether the compound is involved in a 35 U.S.C. 102 or 35

U.S.C. 103 rejection, we totally disagree. ... We think, rather, that the true test of any prior art relied upon to show or suggest that a chemical compound is old, is whether the prior art is such as to place the disclosed 'compound' in the possession of the public.

In re Brown, 141 USPQ 245, 248-49 (CCPA 1964) (emphasis in original) (citations omitted). Similarly, see In re Hoeksema, 158 USPQ 596, 600 (CCPA 1968) (emphasis in original):

We are certain, however, that the invention as a whole is the claimed compound and a way to produce it, wherefore appellant's argument has substance. There has been no showing by the Patent Office in this record that the claimed compound can exist because there is no showing of a known or obvious way to manufacture it; hence, it seems to us that the 'invention as a whole,' which section 103 demands that we consider, is not obvious from the prior art of record.

While there are valid reasons based on public policy as to why this defect in the prior art precludes a finding of obviousness under section 103, In re Brown, supra, its immediate significance in the present inquiry is that it poses yet another difference between the claimed invention and the prior art which must be considered in the context of section 103. So considered, we think the differences between appellant's invention as a whole and the prior art are such that the claimed invention would not be obvious within the contemplation of 35 U.S.C. 103.

"To serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." Continental Can Co. USA Inc. v. Monsanto Co., 20 USPQ2d 1746, 1749 (Fed. Cir. 1991). "Inherency, however may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." Id., quoting Hansgirk v. Kemmer, 40 USPQ 665, 667 (CCPA 1939) (emphasis in original).

With respect to the Sugoh patent, the Sugoh patent describes a solution based method for the production of metal oxides. Examples 1 and 2 of the Sugoh patent relate to silica ( $\text{SiO}_2$ ). The particle size growth for the silica particles is shown in Fig. 5. Table 1 includes a summary of the final particle sizes for aluminum oxide. The final particle size in the Sugoh patent for alumina is 1.2 microns, which is more than a factor of two larger than Applicants' claimed particle size. Furthermore, the Sugoh patent does not teach or suggest the claimed narrow particle size distributions claimed by Applicants.

With respect to the Ota patent, the Ota patent discloses a flame synthesis method for producing ultra-fine powders. Flame methods are a well known approach for the production of inorganic powders. As demonstrated by the Ota patent, nanoscale powders can be produced using flame methods. However, the explosive nature of the flame process results in particles with a significant range in particle sizes. As reported in Table 1 of the Ota patent, the  $\text{Al}_2\text{O}_3$  particles are reported to have particle sizes ranging from 10-100 nm. They do not report an average particle size, although it is presumably about 50 nm. Generally, when reporting values in this way, the range covers a reasonable majority of the particles excluding the tails of the particle distribution. These broad distributions are very different from those disclosed and claimed by Applicants. The Helble patent describes a similar flame process and provides a plot of the particle size distribution.

In the Helble patent, the flame apparatus is designed to produce a short residence time. See, for example, the abstract. A short residence time should lead to a narrower particle size distribution. In Applicants' approach, the light beam creates a small, well defined reaction zone for particle formation. The well defined reaction zone leads to the extremely small particle size distributions. In contrast, in the Helble method, the particles have a wide range in particle sizes, as visibly seen in their Figs. 3A and 3B. The resulting particle size

distribution is plotted in Fig. 4 of the Helble patent. First, it is clearly seen that there are many particles with larger diameters greater than 100 nm. This corresponds to a large tail in the distribution. The distribution is plotted in a log scale, which dramatically constricts the spread of the distribution. If the average particle size is about 15 nm, there are many particles with a diameter greater than 4 times the average, i.e., 60 nm. Similarly, many more than 5 percent have diameter greater than 60 percent more than the average. Thus, the Helble process does not lead to the claimed materials. Similarly, the Ota process, which is similar to the Helble process, cannot lead to the claimed materials.

With respect to the Arai patent, Applicants do not disagree that the Arai patent discloses the production of metal oxides. But Applicants assert that these metal oxides do not include alumina. The Arai patent discloses the production of iron oxide, nickel oxide and aluminum oxyhydroxide. See column 4, lines 31-34 and Table 1. It is ambiguous from the disclosure of the Arai patent whether they consider aluminum oxyhydroxide to be a metal oxide. On the other hand, it is clear from Applicants' specification and from conventional usage that aluminum oxyhydroxide is not a metal oxide, as used in the claims. Applicants have previously enclosed relevant pages from the CRC Handbook of Chemistry and Physics to indicate the distinction between aluminum oxide with a hexagonal crystal structure ( $\text{Al}_2\text{O}_3$ ) and aluminum oxyhydroxide with an orthorhombic crystal structure ( $\text{AlOOH}$ ). The Arai patent does not claim to be able to produce aluminum oxide as claimed by Applicants since the method in the Arai patent produces aluminum oxyhydroxide rather than aluminum oxide. Thus, the Arai patent does not teach or suggest Applicants claimed invention.

With respect to the Moser patent, the Moser patent describes a solution based approach for the production of metal oxide powders. Applicants note that in Table II of the Moser patent, the chemical formula is presented for each of the species except for the aluminum species. This strongly suggests

that Moser et al. were not confident that they had produced alumina ( $\text{Al}_2\text{O}_3$ ). At column 6, lines 1-6, the Moser patent indicates that Transmission Electron Microscopy was used to evaluate each of the materials. However, no particle morphology or particle size is given for alumina. Thus, the results in the Table suggest that no nanoscale particles were formed of alumina. Even for the  $\text{TiO}_2$  particles, Fig. 6 of the Moser patent shows large agglomerates with no distinguishable particles indicative of a particle size distribution extremely different from the distributions disclosed and claimed by Applicants. Thus, in the Moser process, the particle size distribution would clearly be much larger than the particle sizes presented in Applicants' claims. In summary, the Moser process does not inherently disclose the claimed nanoparticles and does not disclose methods suitable for the production of the claimed nanoparticles.

Applicants believe that they have established that none of the five cited patents above inherently disclose Applicants' claimed invention. Furthermore, none of the methods disclosed in these patents are suitable for the production of Applicants' claimed materials. Applicants respectfully request withdrawal of the rejection of claims 1-3, 5-8 and 19-22 as being unpatentable over any one of the Sugoh patent, the Ota patent, the Arai patent, the Moser patent and the Helble '708 patent.

Rejection of Claims 1-3, 5-16 and 19-22 Over a Combination of References

The Examiner rejected claims 1-16 and 19-20 under 35 U.S.C. §103(a) as being unpatentable over either U.S. Patent 5,804,513 to Sakatani et al. (the Sakatani patent) alone or in view of U.S. Patent 5,697,992 to Ueda et al. (the Ueda patent), the Ueda patent alone, U.S. Patent 5,868,604 to Atsugi et al. (the Atsugi patent) alone or in view of the Ueda patent, U.S. Patent 4,021,263 to Rosenblum (the Rosenblum patent) alone or in view of the Ueda patent, U.S. Patent 5,228,886 to Zipperian (the Zipperian patent) alone or in view of the Ueda patent, U.S. Patent 5,300,130 to Rostoker (the Rostoker '130 patent) alone or

in view of the Ueda patent, U.S. Patent 5,389,194 to Rostoker et al. (the Rostoker '194 patent) alone or in view of the Ueda patent, or U.S. Patent 5,527,423 to Neville et al. (the Neville patent) alone or in view of the Ueda patent. The Examiner points to various citations in these patent referring to aluminum oxide particles having a nanometer size. Applicants do not repeat their arguments from the Amendment of May 1, 2000. Instead, Applicants present evidence that the disclosed methods are not suitable for producing the claimed materials.

Applicants note that the Sakatani patent, the Ueda patent, the Atsugi patent, the Rosenblum patent and the Zipperian patent do not assert that they are producing aluminum oxide by any new methods. Only the Neville patent and the Rostoker patent assert the availability of new forms of aluminum oxide. Applicants discuss the Rostoker patent in detail below after discussing the other patents.

The Sakatani patent discloses the use of known approaches for the production of aluminum oxides. See column 4, lines 64-67. A solution based method and a flame method are specifically mentioned. See column 5, lines 1-14. Flame methods were discussed above with respect to the Helble patent. Flame methods do not lead to the narrow particle size distributions claimed by Applicants. Equilibrium solution based methods also lead to large particle size distributions. Specifically, the Sakatani patent discusses the hydrolysis of an aluminum alkoxide. Hydrolysis of an alkoxide is the subject of the Sugoh patent discussed above. Such a hydrolysis approach similarly does not lead to the claimed narrow particle size distributions.

The Ueda patent has the same assignee as the Sakatani patent and has overlapping disclosure. The Ueda patent does not disclose any information beyond what was disclosed in the Sakatani patent. See, for example, column 3, line 12 to column 4, line 15 and Example 1 in comparison with Example 1 of the Sakatani patent.

The Atsugi patent describes the use of commercially available aluminum oxide. See column 3, lines 4-9 and 56-65.

Commercially available aluminum oxide particles certainly do not have the narrow distributions of particle sizes disclosed and claimed by Applicants. The Declaration of Dr. Kambe attests to this issue.

The Rosenblum patent and the Zipperian patent do not disclose methods or sources for their aluminum oxide. Presumably, they refer to the use of commercially available aluminum oxides. Thus, these patents are not particularly relevant to the rejections since they cannot inherently disclose the present invention since certainly commercial materials are available that do not meet the claimed particle size distributions. The extensive discussion herein and Dr. Kambe's earlier Declaration provide further support of the irrelevance of these references.

The Neville patent discloses a flame synthesis method for production of aluminum oxide particles. The Neville patent not only describes polishing with alumina particles with an average diameter less than 500 nm, but the patent also describes the production approach and particle size distribution of the secondary particles in a dispersion. The Neville patent discloses a flame synthesis approach without disclosing significant details of the process, column 6, lines 6-34. The secondary particle size distribution for flame synthesized particles is presented in Fig. 2 of Neville. No information is presented for the primary particle sizes, although the primary particles sizes for flame synthesized particles is presented by the Helble '708 patent, as described above. However, their secondary particle size distribution is significantly narrower than the primary particle size distribution of particles produced by a flame synthesis approach described in the Helble '708 patent, for example, see figure 4 of the Helble '708 patent discussed above. Nevertheless, even the narrower secondary particle size distribution shown in Fig. 2 of the Neville patent is considerably broader than the distribution disclosed and claimed by Applicants.

Assuming that the secondary particle size distribution

presented in the Neville patent corresponds to the primary particle size distribution, with respect to Applicants' claim 1, the distribution in Fig. 2 of the Neville patent has a significant tail. At the tail, the distribution is dropping off about a factor of five for every 50 nm along the Y axis. Thus, the distribution would not fall off to having less than 1 per million particles until about 500 nm, more than a factor of five greater than the average diameter. Nevertheless, Applicants have previously amended claim 1 to indicate that the particle size distribution has a value of less than 1 per million particles by a diameter that is a factor of three relative to average diameter. As presently amended, Applicants' claim 1 accounts for any possible moderation of the tail in the Neville distribution at larger particle diameters. However, any error in the tail of the distribution shown in the Neville patent almost certainly would correspond to a corrected distribution with an extended tail more similar to the tail shown in the Helble '708 patent.

Thus, the Neville patent falls far short of Applicants' claimed distribution. With respect to claim 19, the Neville patent is significantly broadened at both small particle sizes and at larger particles sizes relative to Applicants' claimed distribution. In conclusion, the Neville patent does not teach or suggest Applicants' claimed invention.

The Rostoker patent described the use of nanoparticles of  $\text{Al}_2\text{O}_3$ . The Rostoker patent discloses only one approach for obtaining nanoparticles of  $\text{Al}_2\text{O}_3$ , a process described in U.S. Patent 5,128,081 to Siegel et al. (the Siegel patent). The Siegel patent describes the use of a gas phase condensation approach to producing the particles. This approach leads to a tail at larger particle sizes that brings the distribution outside of Applicants' claimed ranges. As evidence of this, Applicants previously enclosed a copy of a reference by Siegel et al., J. de Physique C5: Supplement 10 681-686 (October 1988) with their earlier Amendment. The inset in figure 1 shows a particle size distribution for titanium dioxide produced by the

gas phase condensation approach. The discussion below figure 1 refers to the distribution as "typical of the particle-size distribution produced in the gas-condensation method."

The long tail at larger particle sizes in the distribution clearly distinguishes the materials from those claimed by Applicants. The average "grain size" is about 13 nm, and a significant fraction of the particles have a size larger than 160 percent of the average, i.e., about 21 nm. The elimination of larger particle sizes is critical for polishing applications since larger particles can scratch the surface of the material being polished.

With respect to other availability of the aluminum oxide nanoparticles with a narrower size distribution, we note that Dr. Siegel was instrumental in the formation of Nanophase Technologies Corporation (Nanophase). Nanophase was not able to scale up easily the gas-condensation approach described in the Siegel patent. Thus, a variation on the gas-condensation approach was developed, called Physical Vapor Synthesis Approach. While this new approach is suitable for the production of commercial quantities of powders, the particle size distributions for Physical Vapor Synthesis are considerable broader than those obtained by the gas condensation approach. Applicants enclosed with their earlier amendment an advertisement article by Quinton Ford of Nanophase and pages down-loaded from the Nanophase web site that confirm this conclusion. Therefore, the nanoscale particles needed to form the dispersions claimed by Applicants' claim were not commercially available.

With respect to claim 15, the gas condensation approach and the Physical Vapor Synthesis Approach both produce particle size distributions that are gaussian in character. Gaussian distributions inherently have a long extending tail. Part of this tail can be seen in the distribution in the Siegel et al. reference enclosed. Thus, these approaches will result in particles with a diameter that is five times larger than the average particle size. Therefore, the Rostoker patent does not

anticipate Applicants' claim 15.

In conclusion, none of the cited references teach or suggest the narrow particle size distribution of aluminum oxide nanoparticles as disclosed and claimed by Applicants. Applicants respectfully request the withdrawal of the rejection of claims 1-16 and 19-20 under 35 U.S.C. §103(a) as being unpatentable over either the Sakatani patent alone or in view of the Ueda patent, the Ueda patent alone, the Atsugi patent alone or in view of the Ueda patent, the Rosenblum patent alone or in view of the Ueda patent, the Zipperian patent alone or in view of the Ueda patent, the Rostoker '130 patent alone or in view of the Ueda patent, the Rostoker '194 patent alone or in view of the Ueda patent, or the Neville patent alone or in view of the Ueda patent.

Rejection of Claims 17 and 18 Over Shimo

The Examiner rejected claims 17 and 18 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,064,517 to Shimo (the Shimo patent). The Examiner cites the Shimo patent for disclosing Applicants' claimed invention for the production of nanoscale aluminum oxide particles. Applicants have amended claim 17 to indicate that the reactants are flowed through the reaction chamber. In view of the above amendments and the following comments, Applicants respectfully request reconsideration of the rejections over the Shimo patent.

The Shimo patent describes a process wherein gaseous reactants are placed within a reaction chamber. See, for example, column 2, lines 50-54 and column 7, lines 64-69. The reaction is initiated by irradiating the reactants with light, and the product particles are collected from the walls of the chamber. See, for example, column 8, lines 45-48 and column 9, lines 12-15. The Shimo patent does not teach or suggest reacting a flowing reactant stream. Thus, the Shimo patent does not disclose the first element of Applicants' claimed method, as amended. Since the reaction of a flowing reactant stream is absent from the prior art reference, the Shimo patent does not render Applicants' claims obvious. Applicants respectfully

request withdrawal of the rejection of claims 17 and 18 under 35 U.S.C. §103(a) as being unpatentable over the Shimo patent.

Rejection of Claims 17 and 18 Over A Combination of References

The Examiner rejected claims 17 and 18 under 35 U.S.C. §103(a) as being unpatentable over the references cited against claim 1 further in view of the Shimo patent. The Examiner argues that it would have been obvious to manufacture the aluminum oxide particles described by the references cited against claim 1 using the method disclosed by the Shimo patent. Applicants have amended claim 17 to indicate that the reactants are flowing when the reaction takes place. Applicants respectfully request reconsideration based on the above amendments and the following comments.

As noted above, the Shimo patent does not teach or suggest, Applicants' claimed method. Therefore, it is irrelevant whether or not the Shimo patent can be used to produce the materials disclosed in the other cited references. The cited references alone or in combination do not teach or suggest Applicants' claimed method, as amended. Therefore, the combination of references do not render claims 17 and 18 obvious. Applicants respectfully request withdrawal of the rejection of claims 17 and 18 under 35 U.S.C. §103(a) as being unpatentable over the references cited against claim 1 further in view of the Shimo patent.

Double Patenting

Since the Examiner did not renew the provisional Obviousness-Type Double Patenting rejection over the claims of copending application 08/961,735. Applicants assume that this rejection has been withdrawn in view of Applicants' previous arguments.

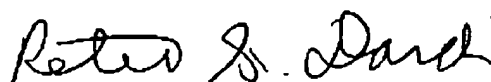
The Examiner has further "suggested" that Applicants file a Terminal Disclaimer over copending application 09/433,202 (the '202 application) even though no rejection was made. Applicants will consider filing a terminal disclaimer once the application has been found otherwise allowable.

CONCLUSIONS

In view of the above amendments and remarks, Applicants submit that this application is in condition for allowance pending a possible obviousness-type double patenting rejection over the '202 application. The Examiner is asked to telephone the undersigned attorney to discuss any remaining issues if the Examiner does not believe that the application is in condition for allowance.

The Director of the Patent and Trademark Office is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 16-0631.

Respectfully submitted,



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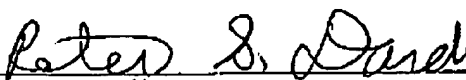
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